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Docket No. F-6485
Date March 31, 2000

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Washington, D. C. 20231

[X] **ATTN: BOX PATENT APPLICATION**
[ ] **ATTN: BOX PCT**

[X] **THIS IS THE NATIONAL STAGE OF PCT/DE98/03034 FILED October 16, 1998**

Sir:

Transmitted herewith for filing is the [**X**] Utility [ ] Design patent application of:

Inventor/Application Identifier: **Roland FISHER et al.**

For: **WOOD COMPONENT AND A METHOD FOR THE PRODUCTION AND APPLICATION OF THE SAME**

Enclosed are:
[X] 1 sheets of drawings ([X] formal [ ] informal size A4).
[X] 11 pages of specification, including claims and abstract.
[X] 12 total pages

[ ] Combined Declaration/Power of Attorney
- [ ] Newly executed
- [ ] Copy from prior application
- [ ] Inventors deleted; see attached statement
- [X] Inventor Information Sheet

[ ] Incorporation By Reference. The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein

[ ] Sequence Listing
- [ ] Computer Readable Copy
- [ ] Paper copy
- [ ] The undersigned hereby affirms that the content of the paper and computer readable copies of the Sequence Listing are the same.

[ ] Cancel in this application original claims _____ of the prior application before calculating the filing fee.

CLAIMS FILED

For	Number Filed	Number Extra		Rate	Basic Fee $840.00
Total Claims	_____	_____	(over 20) x	$18.00	_____
Independent Claims	_____	_____	(over 3) x	$78.00	_____
[ ] Multiple Dependent Claim				$260.00	_____
[ ] Reduce by 50% for Small Entity					_____
[X] Foreign Language Filing Fee				$130.00	**130.00**
				TOTAL FILING FEE	**$970.00**

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[X] Please charge to Deposit Account No. 10-1250 any further fees under 37 CFR 1.16; 37 CFR 1.17; 37 CFR 1.492.

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[ ] Preliminary Amendment

[ ] Assignment to _____.

[ ] Assignment is of record in prior application Serial No. _____.
[ ] Assignment Recordation Form Cover Sheet.
[ ] Charge $40.00 to Deposit Account No. 10-1250 for recording Assignment.

[ ] Information Disclosure Statement and/or Information Disclosure Citation

[ ] English translation

[ ] Small Entity Declaration

[ ] filed herewith

[ ] filed in prior application and status is still proper and desired.

[ ] Applicant hereby claims the benefit of the filing date of the following provisional application(s) under the provisions of 35 USC 119.

[X] Applicant hereby claims the benefit of the filing date of the following applications under the provisions of 35 USC 119 of which certified copies [ ] will follow [ ] are enclosed [X] have been filed in the International Bureau [ ] were filed in prior application No. _____.

German Appln. No. 197 45 706.1 filed October 16, 1997

[ ] This is a [ ] Continuation [ ] Divisional [ ] Continuation-in-Part of prior application Serial No. _____.

[ ] Amend the specification by inserting before the first line the sentence:
--This is a [ ] continuation, [ ] division, [ ] continuation-in-part, of application Serial No. , filed . --

JORDAN AND HAMBURG LLP

By _____
C. Bruce Hamburg
Reg. No. 22,389
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F-6485

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F-6485

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Roland FISCHER et al.
Serial No.	:	09/509,808
For	:	WOOD COMPONENT AND METHOD FOR THE PRODUCTION AND APPLICATION OF THE SAME
Examiner	:	Not yet known
Group Art Unit	:	Not yet known

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Preliminary to examination, please amend this application as follows:

IN THE CLAIMS:

Cancel claims 1-23 and substitute therefor the following claims:

--24. Wood component in which the wood has altered properties in geometrically defined near-surface areas characterized in that said geometrically defined near-surface areas have the properties of solidified wood melts free from pyrolytic degradation products.

25. Component according to Claim 1 characterized in that the geometrically defined near-surface areas are cell walls melted in one or several cutting directions so that the diffusion resistance in said geometrically defined areas to ambient media rises independent of the cutting direction.

26. Component according to Claim 24 or 25 characterized in that said geometrically defined near-surface areas are visually different from non-melted wood in their optical properties absorptivity, reflectivity and diffusing power, and hence, luster.

27. Component according to Claim 24 or 25 characterized in that the geometrically defined near-surface areas have a higher hardness and abrasion resistance.

28. Component according to Claim 24 or 25 characterized in that the deformation behavior in the geometrically defined near-surface areas is altered compared with the original state.

29. Component according to Claim 24 or 25 characterized in that the bulk of the solidified wood melt is in a geometrically defined area of the component below the surface.

30. Component according to Claim 24 or 25 characterized in that the physical and/or chemical properties of the areas are altered by substances incorporated into the solidified wood melt.

31. Component according to Claim 24 or 25 characterized in that the incorporated substances are particles and/or pigments.

32. Method for producing a wood component of Claim 24 or 25 characterized in that

a locally limited or full-area contact-free short-time high energy input into the wood component occurs by electromagnetic waves, whereby a proportion of melted volume of geometrically defined magnitude at or below the surface of the component is produced with the energy input dimensioned such that the proportion of melted volume is produced without pyrolytic degradation processes.

33. Method according to Claim 32 characterized in that electromagnetic waves in form of laser light are used.

34. Method according to Claim 32 characterized in that the duration of the energy input is up to 50 ms.

35. Method according to Claim 32 characterized in that the energy input is carried out through electromagnetic radiation that can be controlled extremely accurately and quickly regarding the lateral extension of the range of interaction, time of interaction and intensity, having a wavelength adapted to the desired depth of the range of interaction.

36. Method according to Claim 32 characterized in that the process is carried out under inert gas.

37. Method according to Claim 32 characterized in that the process is carried out in free atmosphere, i.e. in free air, at room temperature and normal atmospheric pressure.

38. Method according to Claim 32 characterized in that extraneous substances are incorporated into the geometrically defined areas by the melting process.

39. Method according to Claim 35 characterized in that the depth, or thickness of the range of interaction, respectively, according to the objective of the processing action is adjusted

by selection of the wavelength, or range of wavelength, respectively, and the power density of the electromagnetic radiation as well as the time of interaction between the electromagnetic waves and the geometrically defined areas.

40. Method according to Claim 39 characterized in that the lateral extenson of the range of interaction, the time of interaction and the intensity are realized by combination of the relative motion between the beam and the workpiece as well as by methods of dynamic beam forming and beam focusing.

41. Method according to Claim 33 characterized in that the energy input is carried out using a pulse-type laser.

42. Method to Claim 41 characterized in that the time of interaction between the laser beam and the geometrically defined areas is equivalent to the pulse length of the laser.

43. A plurality of components of Claim 24 or 25 characterized in that said components having a melted area are joined with each other by the solidified wood melt free of pyrolytic degradation products.

44. A product characterized in that a wood-free material is joined with said component having a melted area of Claim 24 or 25, by the solidified wood melt free of pyrolytic degradation products.

45. A product according to Claim 44 characterized in that the wood-free material is at least one of transparent polymers and fibrous materials.

46. A product according to claim 20 characterized in that particles or pigments are incorporated into the solidified wood melt free of pyrolytic degradation products.--

REMARKS

This corresponds in substance to an amendment filed in the international stage.

Respectfully submitted,

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BY Herbert F. Ruschmann
HERBERT F. RUSCHMANN
REG. NO. 35, 341

Wood component and a method for the production and application of the same

Description

The invention relates to a wood component in which the wood has altered properties in geometrically defined areas. The invention also relates to a method for producing such components and to the application of said component. The invention can be employed in the woodworking and wood processing industries, in the building and construction industries, and in the craft and trade.

In woodworking, lasers are used for, in addition to surveying processes, cutting and piercing processes. A novel application field is the removal of material using laser irradiation. Seltman, J.: Freilegen der Holzstruktur durch UV-Bestrahlung (Laying bare of the wood structure by UV-irradiation), Holz als Roh- und Werkstoff, Springer-Verlag, 53(1995), pp. 225–228; and Panzner, M. et al.: Experimental Investigation of the Laser Ablation Process on Wood Surfaces, Fourth International Conference on Laser Ablation COLA, Monterey, California, 1997, describe different possibilities and methods for the removal of the wood layer spoiled by mechanical removing processes using electromagnetic beams of different wavelengths.

From DE 94 02 681.5 U1, a device is known for the processing of glass, plastics, semiconductors, wood or ceramics, which uses laser radiation from a laser radiation source that emits laser radiation in form of a laser beam, focussing this laser radiation through a focussing optical system onto a glass, plastic, semiconductor, wood or ceramic material component. This device is characterized in that the laser radiation used has a wavelength of 1.4 µm to 3.0 µm.

This device is designed to enable an effective removing mechanism which is designed to heat the material to be processed very heavily in the range of wavelengths of 1.4 µm to 3.0 µm so that so-called micro-explosions occur. The heated material is removed. This process is used for marking components or generating mechanical stresses in glass tubes to subsequently break them in a melting zone.

In DE 40 33 255 A1 a method is described that is designed to upgrade wood veneers for visual effect by emphasizing the grain. This is reached by pyrolytic browning of the wood surface using IR-radiation. The alterations following the laser cutting of wood and wood materials were investigated, among others, by Parameswaran, N.: Feinstrukturelle Veränderungen

an durch Laserstrahl getrennten Schnittflächen von Holz und Holzwerkstoffen (Fine-structural alterations of laser-cut surfaces of wood and wood materials), Holz als Roh- und Werkstoff, Berlin 40(1982)11, pp. 421–428, who found the following: The brown to black colour of the cutting surfaces is due to the mainly thermal cutting process and typical of a pyrolysis in the cellular areas of separating. A surface largely melted down is produced which very much reduces the diameters of the cell lumina. The high temperatures in the cutting kerf (approx. 700 °C, Arai et al. 1979) lead to a gradual transformation of the wall components into a glassy body. Back, E.L.: Cellulose bei hohen Temperaturen: Selbstvernetzung ... (Cellulose at high temperatures: self-cross-linking ...), Das Papier, 27(1973), pp. 475–483, theoretically determined the melting temperature of cellulose of approx. 450 °C based on the glass temperature. Further, he found that melting without pyrolytic side effects will only be possible if heating and cooling occur in a sufficiently short period of time.

The above-mentioned melting processes when processing wood are considered to be adverse side effects. To date, no alterations of specific wood properties has been created.

In addition to the typical pyrolytical degradation processes when wood is laser-processed, melting is also known as a secondary transformation process. As a rule, melted areas are considered negative concerning the quality of the wood surface processed. Additionally, the pyrolytical degradation products generated in processing are held and solidified in the melt. Known methods, such as laser dividing, confine theirselves to evaporating wood substance by thermal or photochemical coupling of the laser during processing. Thereby, the alteration of the wood structure in the areas adjacent to the processing zone is arbitrary. Degradation processes are not controllable, can hardly be avoided, and lead to a reduced quality of the wood processed in this way. Different methods, such as plasma processing (DE 41 35 697 A1), require much effort to prepare the wood and complicated jigs, which prevents the industrial-scale application.

It is the objective of this invention to describe a wood component as well as a method for the production and application of said component, in which, in geometrically defined areas, the wood has altered properties such that chemically and physically, systematically altered properties of the wood surface follow. This is to avoid any treatment of the wood surface otherwise necessary, and to open a number of new possible uses and fields of application of wood.

According to the invention, the problem is solved using a wood component having the properties listed in Claim 1. A great number of component versions follow from the dependent claims. Further, the problem is solved using a process having the properties listed in Claim

11. Versions of the process follow from the dependent claims. Applications of the component follow from the Claims 22 to 28.

The wood component has altered properties in geometrically defined areas. According to the invention, the geometrically defined areas have exclusively the properties of solidified wood melts. In the context of the dependent Claims 2 to 10 it follows that said areas are single or several wood cells or single or several cell walls. From the melting together, alterations of properties of physical and chemical nature as well as tailored alterations of the deformation behaviour follow.

According to the Claims 22 to 28, the melt can be used for the production of joints of wood components and/or wood particles, or, respectively, reinforcements can be incorporated into the melt.

The main constituents of wood, cellulose, lignin and hemicelluloses, similar to other polymers have no melting point but there is a wide transition interval in phase transformation. In contrast to plastics, wood has no homogeneous structure and, hence, no softening point but a softening temperature range. In wood, thermal degradation processes already start at temperatures lower than 100 °C. However, the critical factor for the beginning and progress of pyrolysis is the duration of heat influence, since pyrolysis is a continuous course of successive degradation processes. Softening starts at temperatures about 100 °C, progressing with a quickly decreasing degree of polymerization of the chains and beginning plasticization. Molten wood is characterized in that it has a low degree of polymerization, increased proportion of amorphous substance, lost fibrillar structure of the cellulose and typical cell structure, homogenization and increased melting temperature when repeatedly heated.

Accordingly, the method to Claim 11 for the production of wood components is established such that the geometrically defined areas are melted by contact-free, short-time, preferably within less than or equal 50 ms, high energy input, so that the degree of polymerization of the chains decreases quickly and plasticization begins, and the melt solidifies within this period of time.

Advantageously, laser light is used as the electromagnetic radiation. The scope of the interaction zone, the interaction period and the intensity are realized by a combination of the relative movement between beam and workpiece as well as through methods of dynamic beam forming. Processing is in a gas atmosphere defined by composition, pressure and temperature. Heating can be in an inert gas atmosphere as well as in free atmosphere. The process of the invention can be combined with other methods of woodworking, e.g. mechanical processing.

Melting can be used within a defined time regime shortly before, during, or shortly after processing using another method.

From the invention, the following advantages result. Melting makes possible to change the structure of wood. Closing the wood cells directly leads to a decrease of the specific surface and the capillary take-up of humidity is reduced, or prevented, respectively. Wood and wood particles can be joined with each other by welding without any, or using solely wood-inherent (e.g. lignin) filling materials. By melting, wood can be joined with other materials, especially transparent polymers or fibrous materials. Melting is possible in a locally limited space or on a complete surface, whereby the proportion of melted volume has a geometrically defined magnitude on or below the surface, thus also defining the degree of alteration of physical and/or chemical properties. By melting, tailored physical and/or chemical alterations are produced in the wood. To realize this, also extraneous substances can be melted into the wood. Said extraneous substances can be particles and/or pigments. Before the melting process they are applied into or onto the wood through, for example, impregnating, immersing, coating, or during the melting process, for example, by means of a gas or powder beam. The diffusion properties of the wood to ambient media are changed. The diffusion properties in the main cutting directions of the wood are essentially homogeneous in melted areas. Melting leads to hydrophobing of the wood surface. Due to the tailored physical and/or chemical alterations, melted wood has an improved resistance to wood pest. Hardness and abrasion resistance of the wood surface can be adjusted. The optical properties (absorptivity, reflectivity and diffusing power) of the wood surface are deliberately altered. The lustre of melted wood is clearly different from that of unmelted wood. Softening of wood substance in the range of glass temperature offers novel possibilities for the deformation of wood.

In the following, the invention is further explained by examples of embodiment.

In order to protect the end of an 8 cm x 10 cm cross-sectioned wood beam from capillary water absorption, a closed surface of melted wood with a maximum thickness of 0.5 mm was produced in the range of the cross-cut grain. To produce this melted area the laser beam of a continuous CO_2-laser with a power of 2500 W and a laser spot diameter of 6 mm was meandered over the cross-cut surface to be processed of the beam end using a double-mirror scanner, with a track overlap of 10 percent and a velocity of 6 m/s.

In order to produce a homogeneous, closed melted zone with a thickness of more than 0.4 mm, the cell structure within the geometrically defined area must be abolished. Therefore, the wavelength and duration of the laser action were chosen such that the solid wood constituents were melted to a depth of approx. 0.8 mm.

The decreased capillary water absorption was evaluated by wetting with a defined water volume and measurement of the time until the complete penetration of the water. The investigation of the melted wood surface showed a penetration time prolonged by the factor 7.1.

Two spruce veneers 3 were welded together by melting of the lignin contained in the wood.

To this end, the veneers 3, first, were smoothed by ironing and fixed in a suitable fixture so that they lie close together without any clearance over the whole weld length.

To produce a weld 5 the laser beam 2 of a continuous CO_2-laser with a power of 2500 W, a spot diameter of 13 mm and a velocity of 12 m/s was linearly moved over the prepared weld area.

In order to produce a homogeneous closed weld 5 of a thickness of, at least, 0.5 mm, the cell structure within the geometrically defined area must be abolished. Therefore, the wavelength and duration of the laser beam 2 were chosen such that the solid wood constituents were melted to a depth of approx. 2 mm.

After processing, both veneers 3 are joined with each other by the weld 5. After separating the two veneers from each other, the microscope clearly shows a fracture edge over the whole weld length. Below the fracture edge a homogeneous melt layer is observed. The cell structure is abolished down to a depth of 0.4 mm.

Nomenclature

1	Beam guiding
2	Laser beam
3	Veneer
4	Processing direction
5	Weld
6	Melt

Claims

1. Wood component in which the wood has altered properties in geometrically defined areas **characterized in that** said geometrically defined areas have the properties of solidified wood melts free from pyrolytic degradation products.

2. Component to Claim 1 **characterized in that** the geometrically defined areas are single or several melted wood cells melted together so that the capillary take-up of humidity in said geometrically defined areas is limited, or prevented, respectively.

3. Component to Claim 1 or 2 **characterized in that** the geometrically defined areas are one or several cell walls melted in one or several cutting directions so that the diffusion resistance in said geometrically defined areas to ambient media rises independent of the cutting direction.

4. Component to any of the above-mentioned Claims **characterized in that** said geometrically defined areas are clearly visually different from non-melted wood in their optical properties absorptivity, reflectivity, diffusing power, and hence, lustre.

5. Component to any of the above-mentioned Claims **characterized in that** the geometrically defined areas have a noticeably higher hardness and abrasion resistance.

6. Component to any of the above-mentioned Claims **characterized in that** the deformation behaviour in the geometrically defined areas is noticeably altered compared with the original state.

7. Component to any of the above-mentioned Claims **characterized in that** the bulk in a geometrically defined area of the component is below the surface.

8. Component to any of the above-mentioned Claims **characterized in that** the physical and/or chemical properties are additionally and deliberately altered by substances incorporated into the melt.

9. Component to Claim 8 **characterized in that** the physical and/or chemical properties are deliberately altered.

10. Component to Claim 8 or 9 **characterized in that** the incorporated substances are particles and/or pigments.

11. Method for producing a wood component to any of the above-mentioned claims **characterized in that** the geometrically defined areas are melted by contact-free, short-time, preferably within less than or equal 50 ms, high energy input so that the degree

of polymerization of the chains decreases quickly and plasticization starts, and the melt solidifies within this period of time.

12. Method to Claim 11 **characterized in that** the energy input is carried out through electromagnetic radiation that can be controlled extremely accurately and quickly regarding the lateral extension of the range of interaction, time of interaction and intensity, having a wavelength adapted to the desired depth of the range of interaction.

13. Method to Claim 11 or 12 **characterized in that** the process is carried out under inert gas.

14. Method to Claim 11 or 12 **characterized in that** the process is carried out in free atmosphere, i.e. in free air, at room temperature and normal atmospheric pressure.

15. Method to any of the Claims 11 to 14 **characterized in that** extraneous substances are incorporated into the geometrically defined areas by the melting process.

16. Method to any of the Claims 11 to 14 **characterized in that** the energy input is by electromagnetic waves.

17. Method to Claim 16 **characterized in that** electromagnetic waves in form of laser light are used.

18. Method to any of the above-mentioned Claims **characterized in that** the depth, or thickness of the range of interaction, respectively, according to the objective of the processing action is adjusted by selection of the wavelength, or range of wavelength, respectively, and the power density of the electromagnetic radiation as well as the time of interaction between the electromagnetic waves and the geometrically defined areas.

19. Method to any of the above-mentioned Claims **characterized in that** the lateral extension of the range of interaction, the time of interaction and the intensity are realised by combination of the relative motion between beam and workpiece as well as by methods of dynamic beam forming and beam focussing.

20. Method to any of the Claims 11 to 19 **characterized in that** the energy input is carried out using a pulse-type laser.

21. Method to Claim 20 **characterized in that** the time of interaction between the laser beam and the geometrically defined areas is equivalent to the pulse length of the laser.

22. Application of the component to Claim 1 to 10 **characterized in that** building parts consisting of several components of wood parts and/or wood particles are manufactured by joining said components through the wood melt.

23. Application of the component to Claim 22 **characterized in that** wood parts and/or wood particles are joined with each other by welding.

24. Application of the component to Claim 23 **characterized in that** wood parts and/or wood particles are joined with each other by welding using wood-inherent filling materials.

25. Application of the component to Claim 24 **characterized in that** lignin and/or cellulose are used as wood-inherent filling materials.

26. Application of the component to any of the above-mentioned Claims **characterized in that** building parts consisting of several components, at least one of which is wood, are manufactured by joining of the wood parts and/or wood particles with other components.

27. Application of the component to Claim 26 **characterized in that** said other components that are not wood, are transparent polymers and/or fibrous materials.

28. Application of the component to Claim 26 or 27 **characterized in that** the wood parts and/or wood particles are welded with other components by melting.

With 1 sheet of drawings.

Abstract

The invention relates to a wood component in which the wood has altered properties in geometrically defined areas. Said geometrically defined areas exclusively comprise the properties of solidified melting wood. The invention also relates to a method for producing such components and to the application of said component.

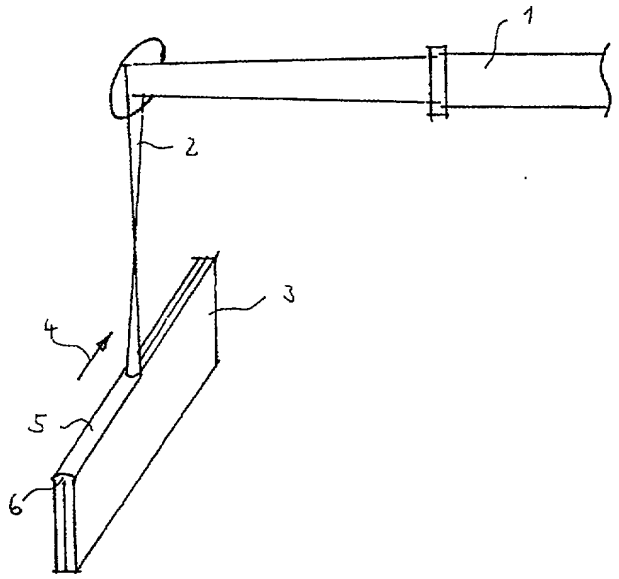

Fig. 1

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney's Docket Number F-6485

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

WOOD COMPONENT AND A METHOD FOR THE PRODUCTION AND APPLICATION OF THE SAME

the specification of which (check only one item below):

[ ] is attached hereto.

[ ] was filed as United States application

Serial No. _____

on _____,

and was amended

on _____ (if applicable).

[X] was filed as PCT international application

Number PCT/DE98/03034,

on October 16, 1998

and was amended under PCT Article 19

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

Country (if PCT indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 USC 119
Germany	197 45 706.1	16 October 1997	[X] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Continued) (Includes Reference to PCT International Applications)	Attorney's Docket Number F-6485

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check One)		
U.S. Application Number	U. S. Filing Date	Patented	Pending	Abandoned

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT Application No.	PCT Filing Date	U.S. Serial Numbers Assigned (if any)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1.

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Full Name of Sixth Joint Inventor	Inventor's Signature	Date
Residence		Citizenship
Post Office Address		

Full Name of Seventh Joint Inventor	Inventor's Signature	Date
Residence		Citizenship
Post Office Address		

Full Name of Eighth Joint Inventor	Inventor's Signature	Date
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